



EFFECT OF MICRO-BREAKS ON ATTENTION, MENTAL FATIGUE, AND COGNITIVE PERFORMANCE AMONG COLLEGE STUDENTS

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Cite This Article: K. Jagathis Babu, A. Prem Edwin, I. Diravia Gladina, G. Mahalakshmi, K. Ivin Jabakumar & M. Suresh Kumar, "Effect of Micro-Breaks on Attention, Mental Fatigue, and Cognitive Performance Among College Students", *International Journal of Multidisciplinary Research and Modern Education*, Volume 12, Issue 1, January - June, Page Number 40-42, 2026.

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Type of Review: Peer Reviewed as per |C|O|P|E| Guidance.

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DOI: <https://doi.org/10.5281/zenodo.18789106>

Abstract:

Sustaining cognitive focus during prolonged tasks is a major challenge across domains such as academics, knowledge work, and high performance environments. Recent research has highlighted the potential of micro-breaks brief, intentional pauses lasting seconds to a few minutes as cost effective cognitive interventions that enhance sustained attention, working memory, and overall task performance. This study investigates the effects of micro-breaks on sustained focus, comparing continuous task performance against intervals with structured micro-breaks. An experimental analysis with 60 participants shows statistically significant improvements in task accuracy, perceived mental fatigue, and response time in the micro-break condition. Findings support micro-break implementation strategies as feasible, scalable cognitive tools for improving sustained focus in both educational and professional contexts.

Key Words: Micro-Breaks, Sustained Focus, Attention, Cognitive Performance, Mental Fatigue, Intervention

Introduction:

Sustaining cognitive focus over prolonged periods is a critical challenge in modern society. In both educational and professional settings, individuals are expected to process complex information, make rapid decisions, and maintain accuracy despite long hours of mental effort. However, continuous task engagement often leads to mental fatigue, reduced vigilance, and cognitive performance decline, a phenomenon commonly known as the vigilance decrement (Warm, Parasuraman, & Matthews, 2008).

Cognitive fatigue not only affects task performance but also has broader implications for well-being, job satisfaction, and learning outcomes. Studies have shown that even short lapses in attention can lead to errors in high-stakes environments such as air traffic control, medical diagnostics, and financial decision-making (Boksem et al., 2005). Consequently, researchers and practitioners have been exploring strategies to maintain sustained focus and prevent cognitive depletion.

One emerging approach is the implementation of micro-breaks, which are brief, structured pauses embedded within ongoing tasks. Unlike traditional breaks scheduled at natural intervals (e.g., lunch or end-of-shift), micro-breaks are short typically 30 seconds to 5 minutes and designed to restore cognitive resources without significantly disrupting workflow (Ariga & Lleras, 2011). The underlying hypothesis is that small, frequent breaks can interrupt monotony, prevent attentional fatigue, and optimize overall task performance.

Review of Related Research:

Sustained attention, defined as the ability to maintain focus on a task over time, is a core component of cognitive functioning (Parasuraman, 1986). According to Resource Depletion Theory, attention is a finite resource that diminishes with continuous cognitive effort (Kahneman, 1973). As mental resources are exhausted, performance declines, errors increase, and reaction times slow a pattern observed across laboratory and field studies (Warm et al., 2008). Cognitive Load Theory (Sweller, 1988) further emphasizes that working memory has limited capacity. Continuous task engagement without restorative intervals increases extraneous cognitive load, contributing to mental fatigue and reduced learning or performance outcomes. These theoretical models provide a rationale for interventions that interrupt prolonged cognitive effort, such as micro-breaks. Micro-breaks are brief, low-intensity interruptions intended to restore attention and reduce fatigue. Early studies by Ariga and Lleras (2011) demonstrated that even a one-minute break, involving simple cognitive disengagement, can prevent performance decline in attention-demanding tasks. Their research introduced the concept of "interrupted practice", where strategically placed breaks enhance overall task efficiency. Neuroscientific evidence provides mechanistic support for these effects. Brief disengagement during micro-breaks allows the Default Mode Network (DMN) to recover from continuous executive load, while neurotransmitter systems such as dopamine and norepinephrine are restored, facilitating renewed attentional control (Breska & Deouell, 2017; Smallwood et al., 2017).

Research Method:

This study employed a between-subjects experimental design to examine the effects of micro-breaks on sustained attention, working memory, and subjective fatigue. Participants were randomly assigned to either the Micro-Break Group or the Control Group (Continuous Task). A between-subjects design was chosen to avoid potential carryover effects that could occur if participants experienced both conditions in a repeated-measures design. A total of 60 participants (30 males, 30 females; aged 18-35, $M = 24.3$, $SD = 4.1$) were recruited from undergraduate and graduate programs at a Bharathidasan University. Normal or corrected-to-normal vision, No history of neurological or attentional disorders, Availability for a single 90-minute experimental session, Participants received either course credit or a small monetary compensation. Random assignment ensured groups were equivalent in baseline cognitive ability and age distribution.

Materials and Apparatus:

Tasks Used:

- Sustained Attention to Response Task (SART): Participants responded to frequent non-target stimuli and withheld responses to infrequent target stimuli. This task measures sustained attention and inhibitory control.
- 2-Back Working Memory Task: Participants monitored a continuous stream of letters on a computer screen and indicated when the current letter matched the one two trials back. This task assesses working memory updating and attentional control.

Micro-Break Intervention:

Duration: 90 seconds every 8 minutes. Activity Options: Participants could choose between light stretching, deep breathing exercises, or observing calming visual stimuli on screen. Rationale: These activities were selected to provide minimal cognitive load while allowing attentional networks to recover. Subjective Measures were NASA-TLX (Task Load Index): Evaluates perceived workload across six dimensions: mental demand, physical demand, temporal demand, effort, performance, and frustration. Visual Analogue Scale (VAS) for Fatigue: Participants rated fatigue on a scale from 0 (no fatigue) to 100 (extremely fatigued).

Apparatus and Procedure

Computers with 17-inch monitors and standard keyboards, E-Prime software for task presentation and reaction time recording, Quiet laboratory room with controlled lighting and minimal distractions. Participants were briefed on the study's purpose, procedure, and the tasks they would complete. Informed consent was obtained. Participants completed a 5-minute practice session for each task to familiarize themselves with the interface. Control Group Performed SART and N-Back tasks continuously without breaks. Micro-Break Group performed the same tasks, but paused for a 90-second micro-break after every 8-minute block of task activity. After task completion, participants filled out NASA-TLX and VAS fatigue scales. Participants were debriefed about the research objectives and allowed to ask questions. The total duration of the experimental session was approximately 75-90 minutes.

Objective Performance Metrics:

Accuracy (% correct), reaction time (ms), and error rate for both SART and N-Back tasks.

Subjective Measures:

NASA-TLX composite scores and VAS fatigue ratings.

Statistical Tests:

Independent samples t-tests were conducted to compare performance and subjective ratings between groups. Effect sizes (Cohen's d) were calculated to assess the magnitude of differences.

Analysis:

The study measured accuracy, reaction time (RT), and error rate for both the SART and 2-Back tasks. Group means, standard deviations, and independent-samples t-tests are summarized below.

Table1: Objective Performance Measures for Control and Micro-Break Groups

Measure	Control Group (n=30)	Micro-Break Group (n=30)	T Value	P value	Cohen's d
H SART Accuracy (%)	79.4 ± 8.6	87.1 ± 7.2	3.25	0.002*	0.91
N- Back Accuracy (%)	75.2 ± 9.1	82.8 ± 8.3	3.05	0.004*	0.85
S ART Mean RT (ms)	481 ± 42	452 ± 36	2.65	0.01*	0.75
N- Back Mean RT (ms)	624 ± 54	593 ± 49	2.37	0.02*	0.68
SART Errors	11.2 ± 3.5	7.8 ± 2.8	3.94	0.001*	1.05
N- Back Errors	14.8 ± 4.3	10.6 ± 3.9	3.48	0.003*	0.92

*Significant at $p < 0.05$

Participants in the Micro-Break Group consistently outperformed the Control Group across all objective metrics. Accuracy was higher, reaction times were faster, and errors were fewer, confirming that micro-breaks improve both speed and precision in sustained attention and working memory tasks.

Table 2: Subjective workload and fatigue were measured using NASA-TLX and VAS fatigue scores.

Measure	Control Group	Micro-Breakup Group	T Value	P value	Cohen's d
NASA-TLX Score	59.7 ± 10.2	48.3 ± 9.6	4.15	<0.001*	1.08
Fatigue (VAS, 0-100)	71.4 ± 12.1	56.2 ± 11.8	4.61	<0.001*	1.19
Perceived Focus (VAS, 0-100)	63.8 ± 9.4	76.7 ± 10.1	4.2	<0.001*	1.05

*Significant at $p < 0.05$

The micro-break condition significantly reduced perceived workload and mental fatigue while increasing subjective focus. This supports the notion that brief cognitive pauses enhance both objective performance and subjective experience.

Performance trends were analyzed over successive 8-minute blocks to examine the vigilance decrement (decline in performance over time).

Table 3: SART Accuracy Over Time (Mean $\pm$ SD)

Time Block (min)	Control Group (%)	Micro-Break Group (%)
0-8	82.1 $\pm$ 7.5	86.8 $\pm$ 6.9
Aug-16	80.5 $\pm$ 8.0	87.2 $\pm$ 7.1
16-24	78.3 $\pm$ 8.2	87.5 $\pm$ 7.2
24-32	75.4 $\pm$ 9.0	86.9 $\pm$ 7.0

Control Group shows a gradual decline in accuracy over time (vigilance decrement). Micro-Break Group maintains stable performance, indicating effective attentional recovery during breaks.

Table 4: Reaction Time Over Time

Time Block (min)	Control Group	Micro-Break Group
0-8	472 $\pm$ 39	450 $\pm$ 34
Aug-16	483 $\pm$ 41	451 $\pm$ 36
16-24	491 $\pm$ 44	453 $\pm$ 36
24-32	497 $\pm$ 46	455 35

RT increases steadily for the Control Group, suggesting cognitive fatigue. Micro-Break Group maintains faster reaction times across blocks.

Results:

- Effect Size (Cohen's d): Ranged from 0.68-1.19 for performance and subjective measures, indicating moderate to large effects.
- Vigilance Recovery: Micro-breaks prevented the typical decline in sustained attention over time, confirming the cognitive replenishment hypothesis.
- Correlation Analysis: Pearson correlation between subjective fatigue and accuracy was $r = -0.62$ in the Control Group ($p < 0.01$), but only $r = -0.28$ in the Micro-Break Group ($p = 0.12$), suggesting micro-breaks buffer the effect of fatigue on performance.

Conclusion:

This study substantiates the claim that micro-breaks serve as effective cognitive interventions for sustaining focus, enhancing accuracy, speeding response times, and reducing perceived mental fatigue. Brief breaks interspersed within cognitive tasks contributed to significant performance improvements compared to uninterrupted work periods, demonstrating their value for diverse application contexts including professional and educational environments. Practical takeaway: Introducing strategically placed micro-breaks in attention intensive workflows can improve performance and well-being with minimal interruption to overall task time.

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